



Stand age structure and growth responses to disturbance and climate variability in forest monitoring plots, Southwest Alaska Network

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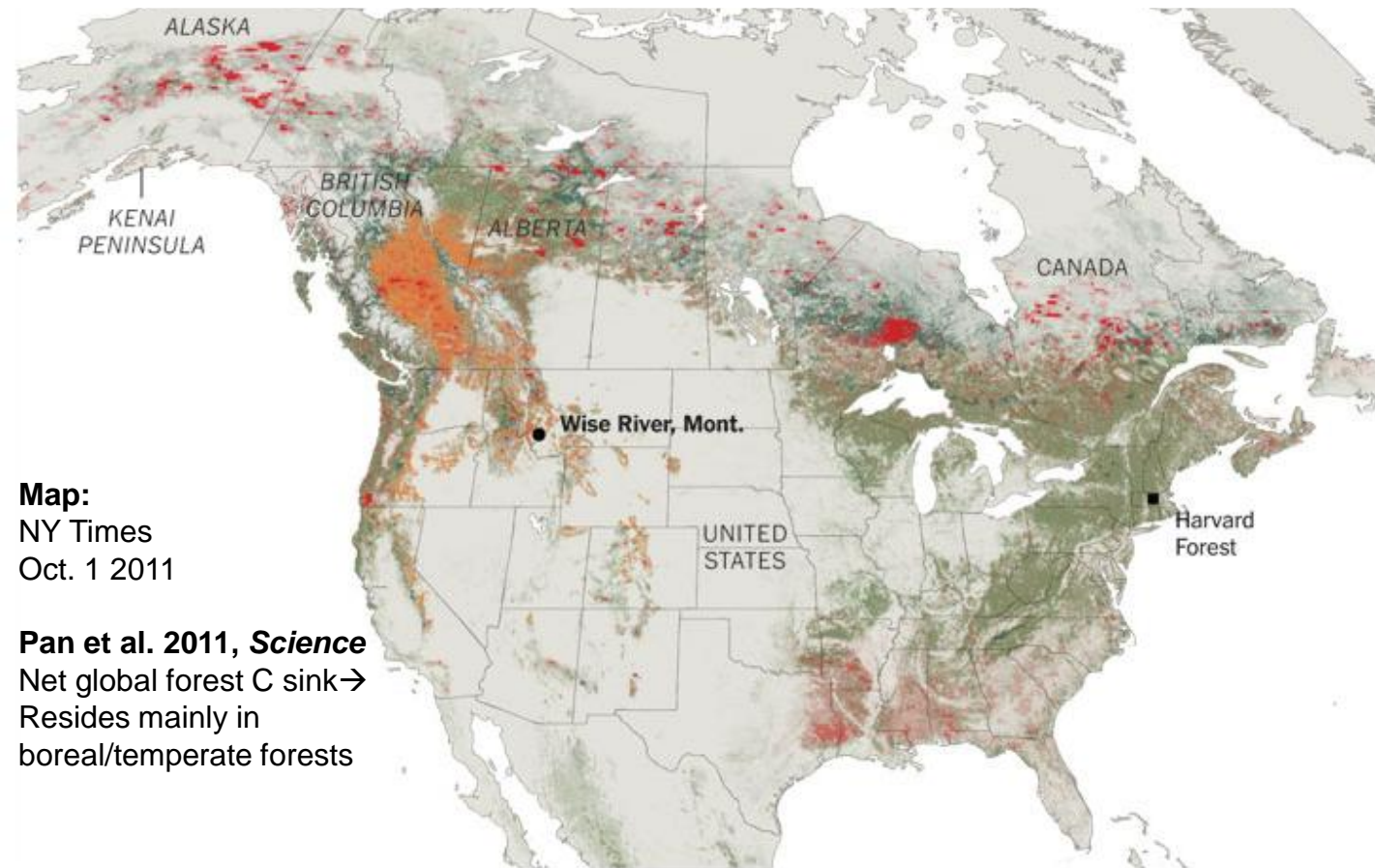


Funding and Support:
Southwest Alaska Network, National Park Service



“With deaths of forests, a loss of key climate protectors” Oct. 1, 2011 NY Times

Concerns for Forest Ecosystems: Climate, Disturbance,
Stress → Carbon sink to source?



Map:
NY Times
Oct. 1 2011

Pan et al. 2011, *Science*
Net global forest C sink →
Resides mainly in
boreal/temperate forests

Intact Forests

Natural ecosystems relatively
undisturbed by human activity.



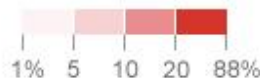
Fragmented Forests

Forests disturbed by roads,
logging or other human activity.



Recent Losses

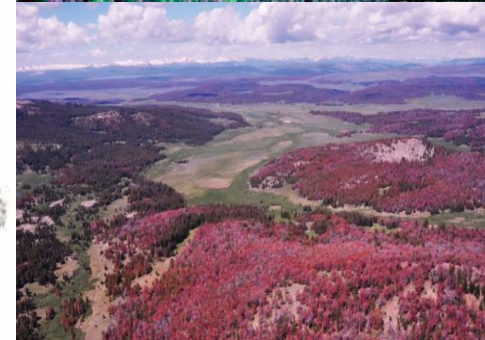
Gross area of forest lost
from 2000–5.



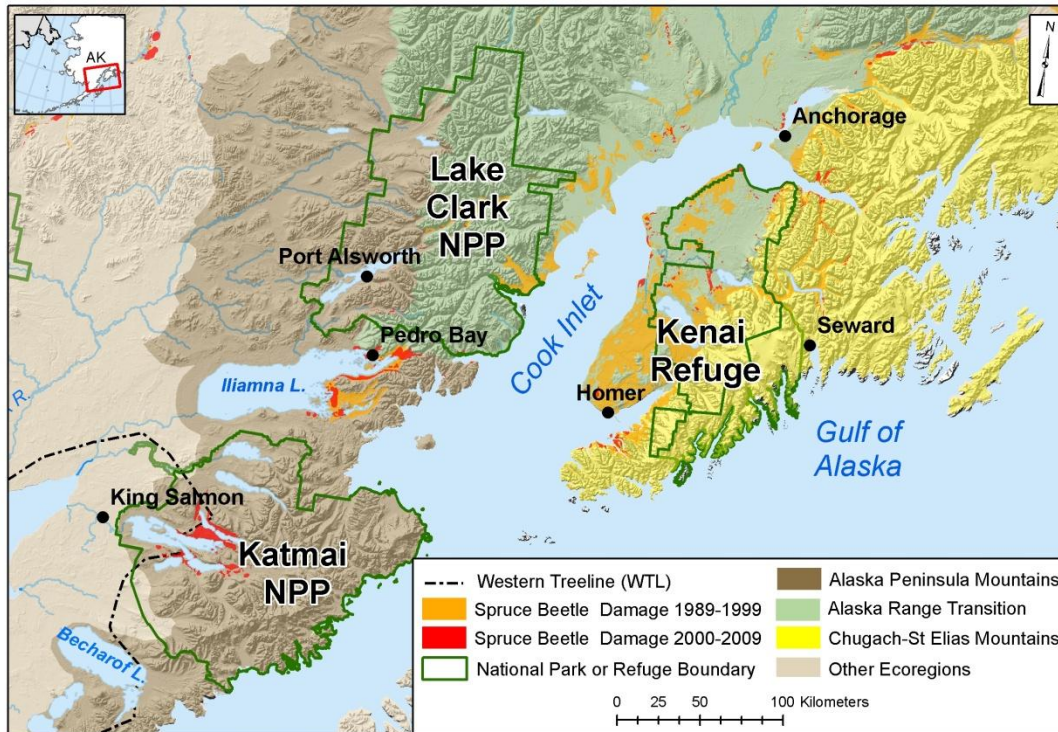
Ancient Forests

Estimated extent of forests
8,000 years ago.

Areas affected by the mountain
pine beetle in Canada, 1999–2010,
and the U.S., 2005–20 (projected)



Key question for southwest and south-central Alaska forest ecosystems

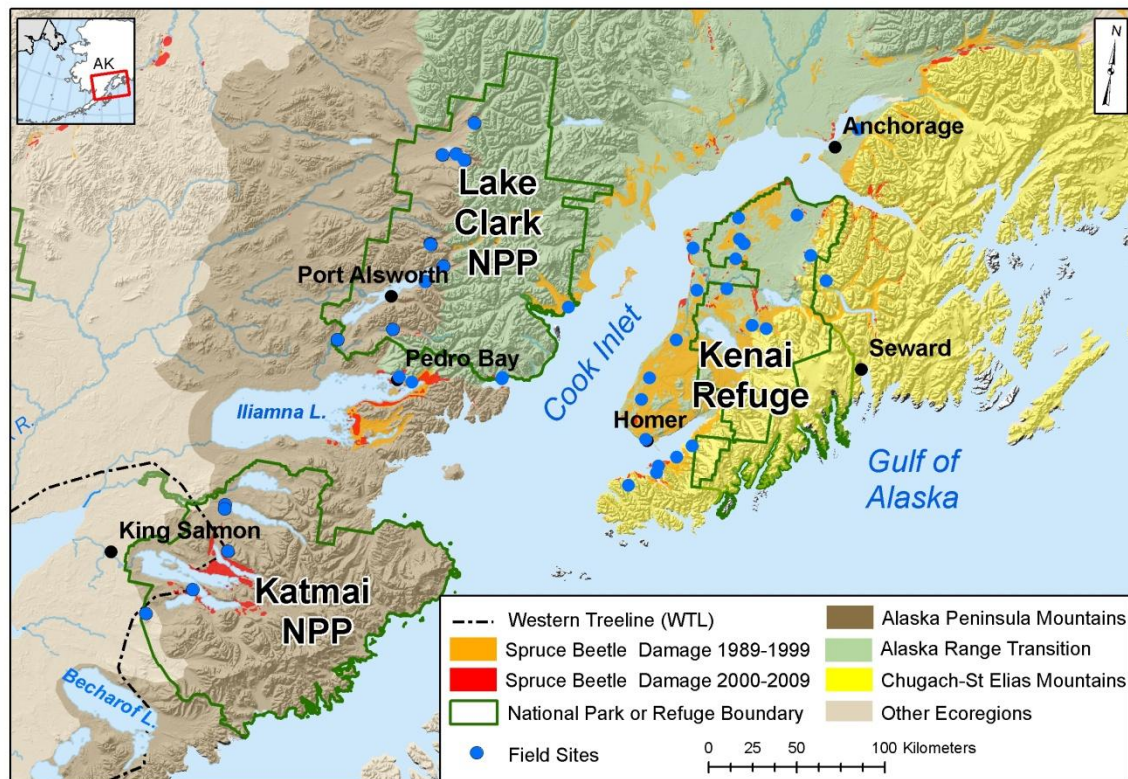


What are past and current effects of spruce beetle disturbance and climate warming on white spruce ecosystems?

Sherriff, Berg and Miller. 2011. Climate variability and spruce beetle (*Dendroctonus rufipennis*) outbreaks in south-central and southwest Alaska. *Ecology* 92: 1459-1470.

Spruce Beetle Study Sites

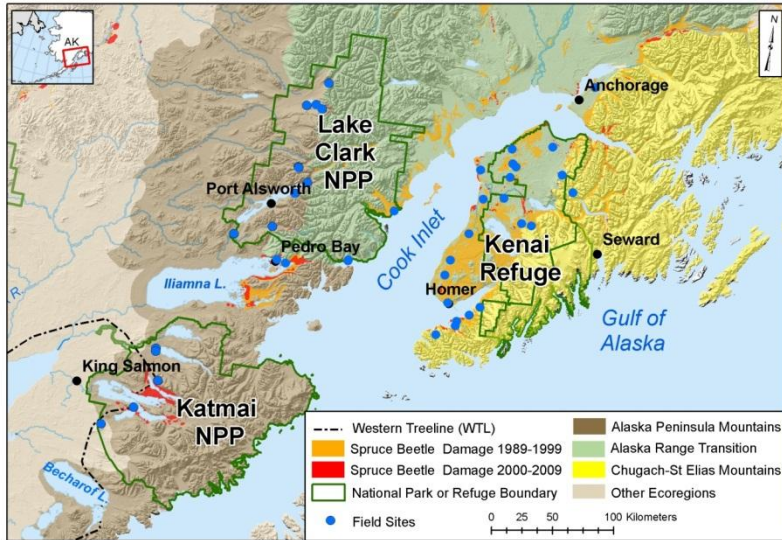
Collaborators: Ed Berg and Amy Miller



37 sites
white, Sitka, Lutz spruce
~ 3100 tree cores

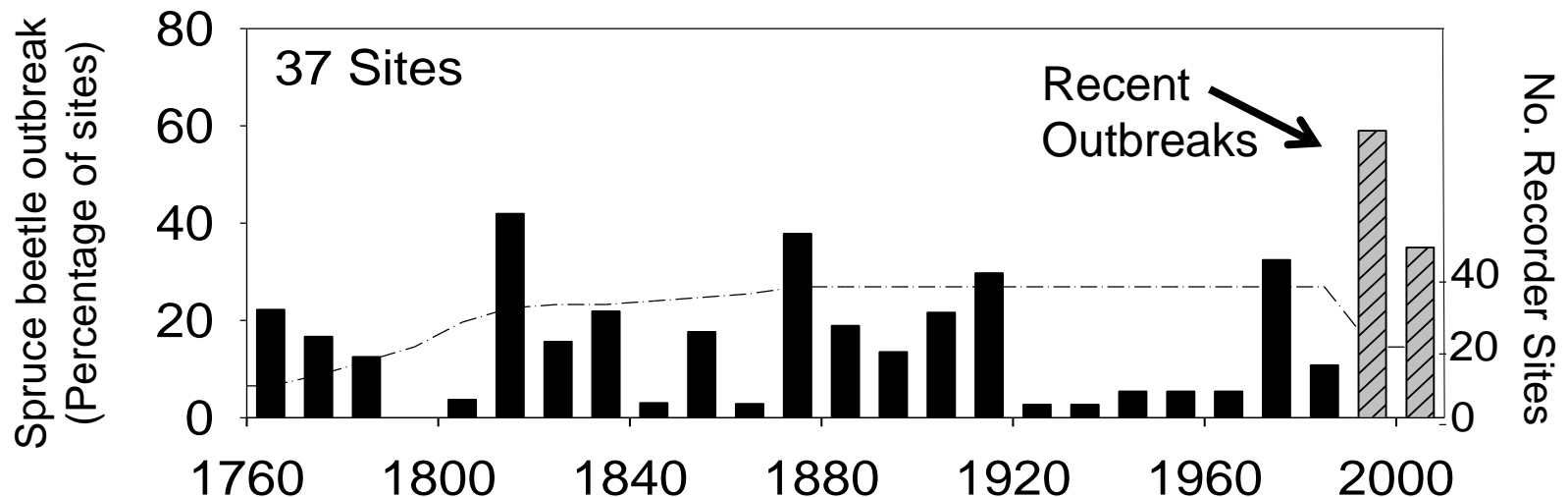
Photo by Ed Berg

Results: How *unprecedented* are recent spruce beetle outbreaks?

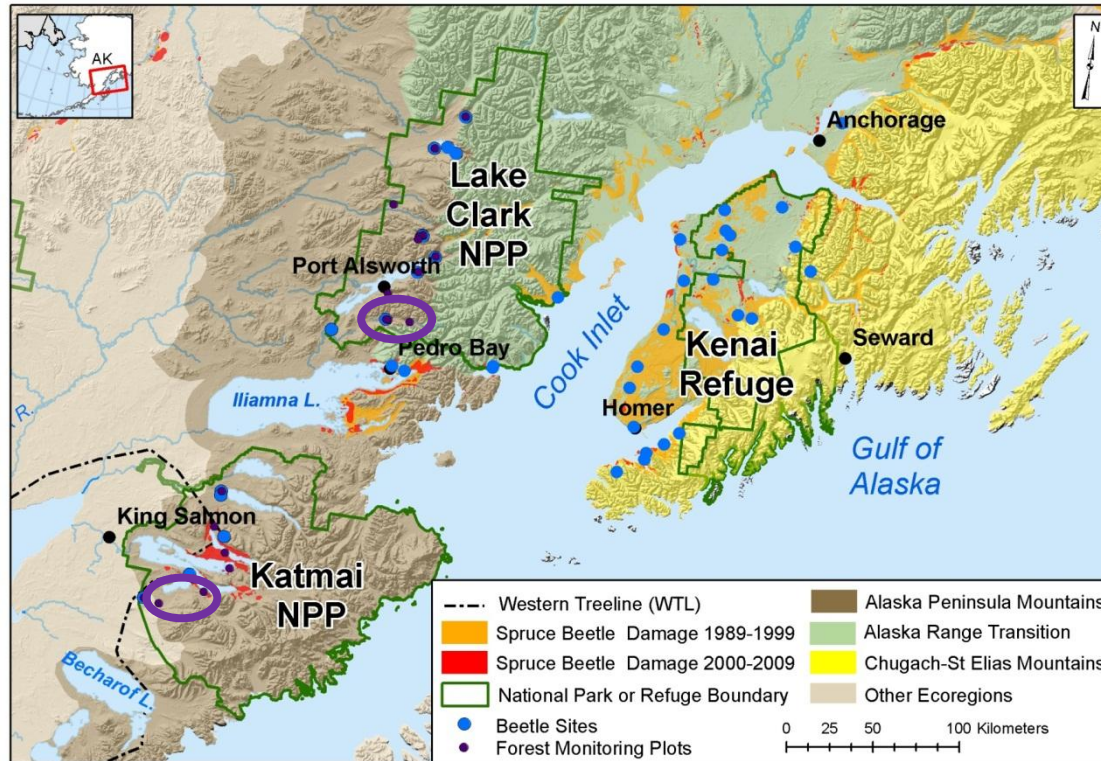


Geographic range is not unique.

Spatial extent of *synchrony* and *severity* apparently unprecedented based on evidence from the last ~250 years.



Southwest Alaska Network - NPS Forest Monitoring Plots



19 monitoring plots (30m²)

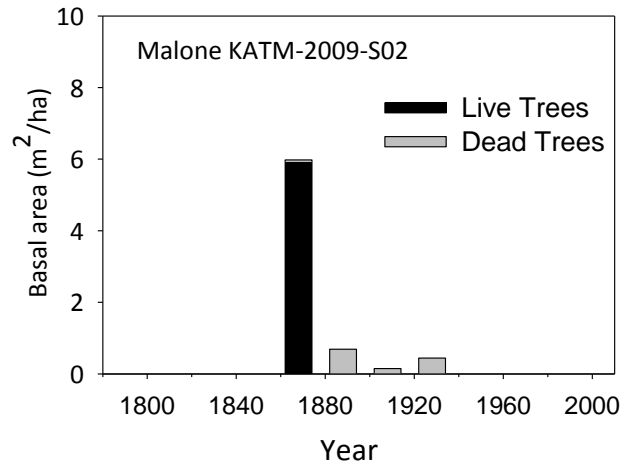
Range of white spruce woodland-forest conditions
Mapped and cored ~ 50 trees/stand (~1000 cores)
Age structure and tree growth-climate interactions

Open Woodland

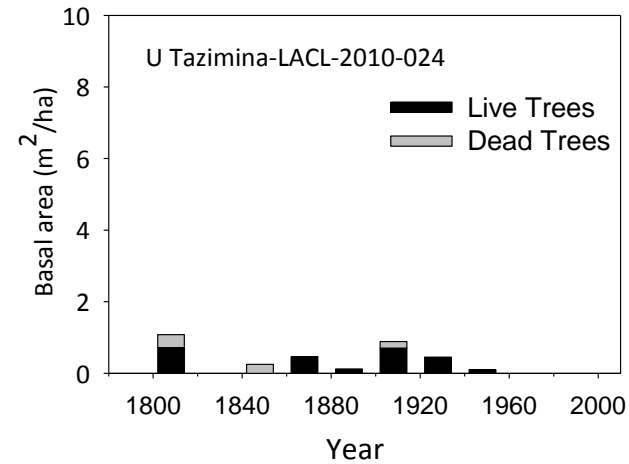
Katmai

Lake Clark

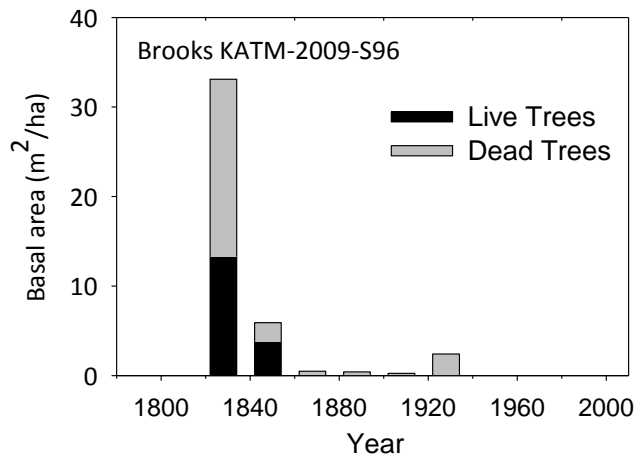
Southern Woodland Site



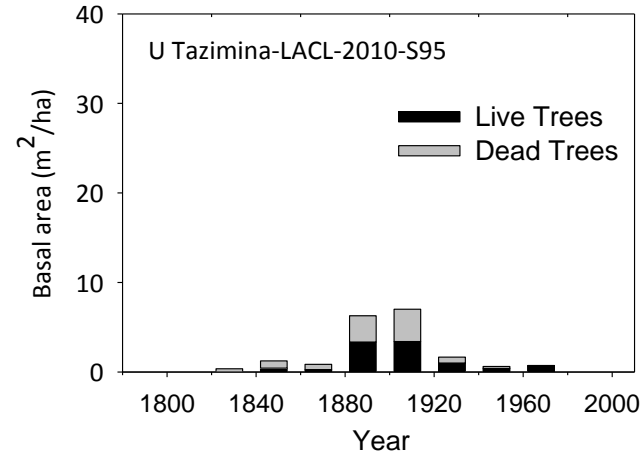
Northern Woodland Site



Southern Forest Site



Northern Forest Site



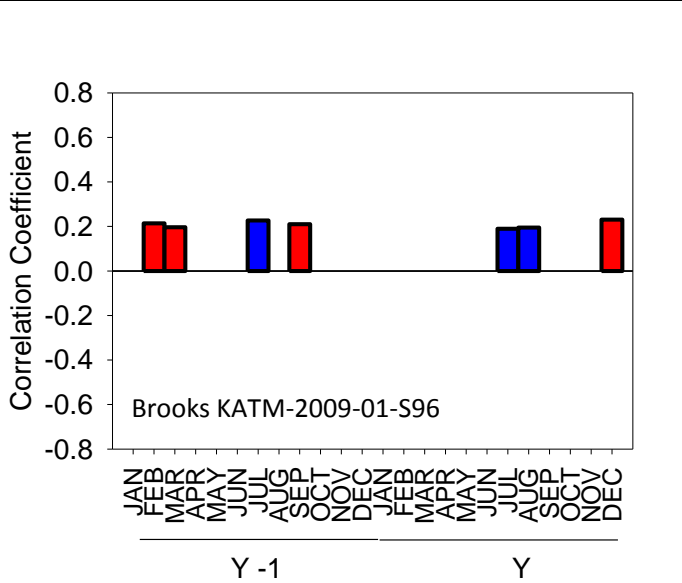
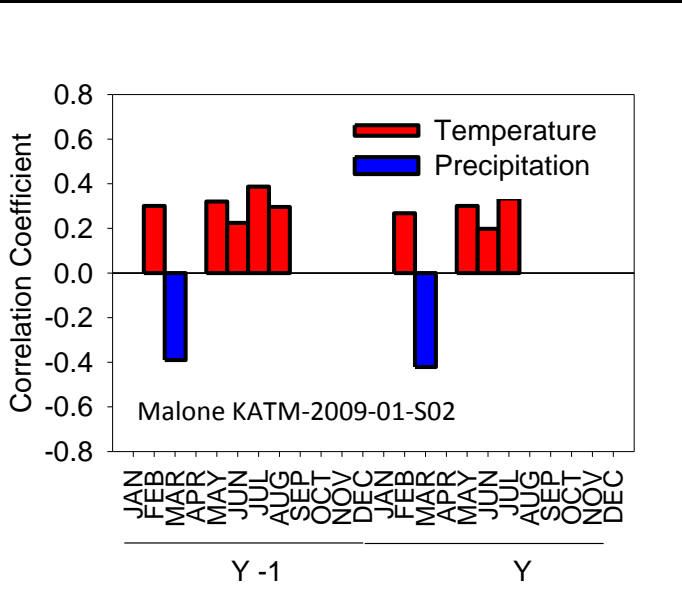
Mesic Forest

Results: Growth-climate trends in spruce ecosystems

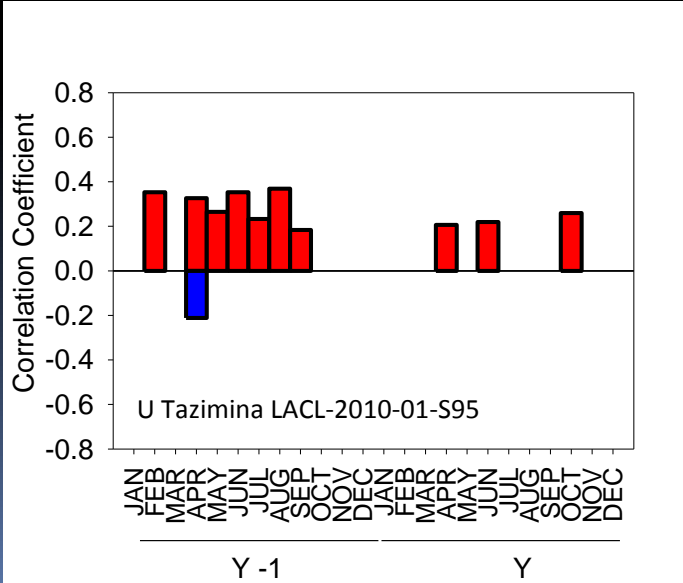
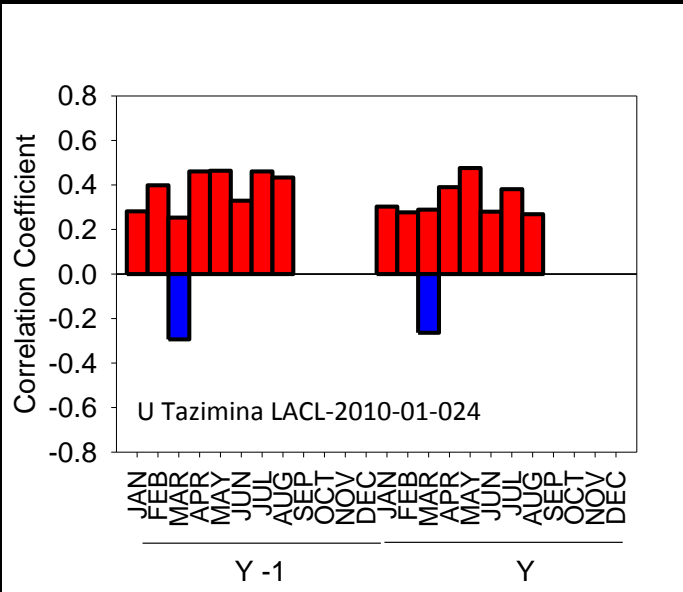
Open Woodland

Mesic Forest

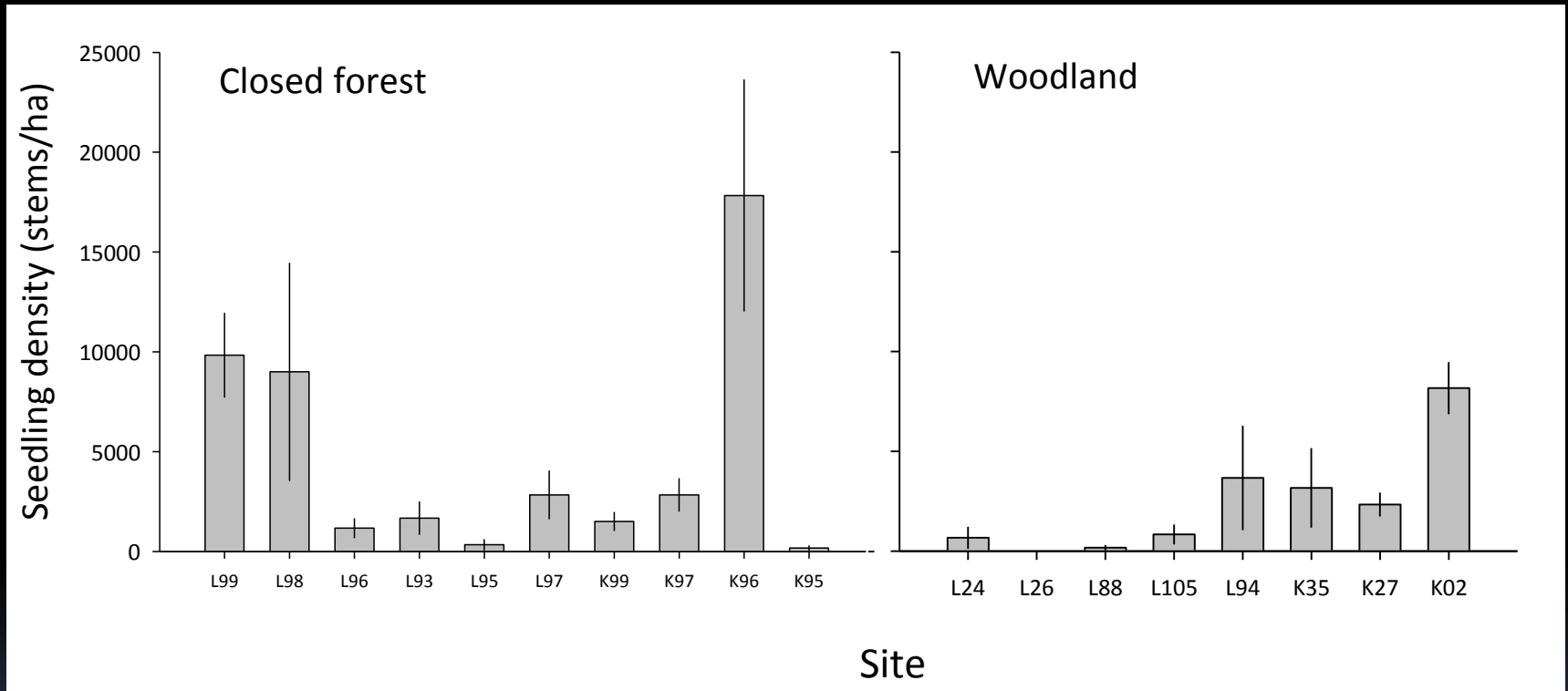
Katmai



Lake Clark



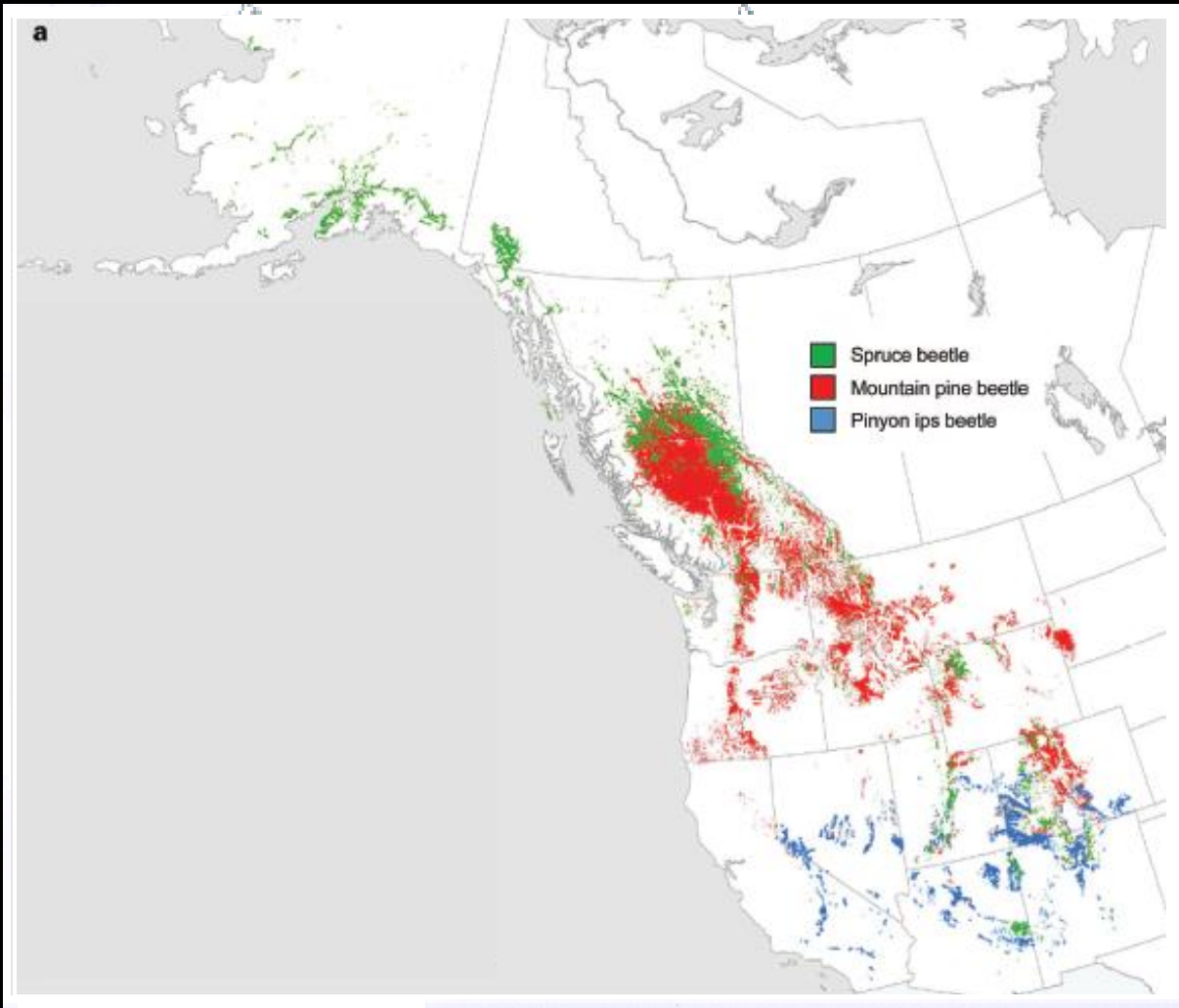
Results: Recruitment across spruce ecosystems



N → S

N → S

Concluding Findings: How *unprecedented* are recent spruce beetle outbreaks?

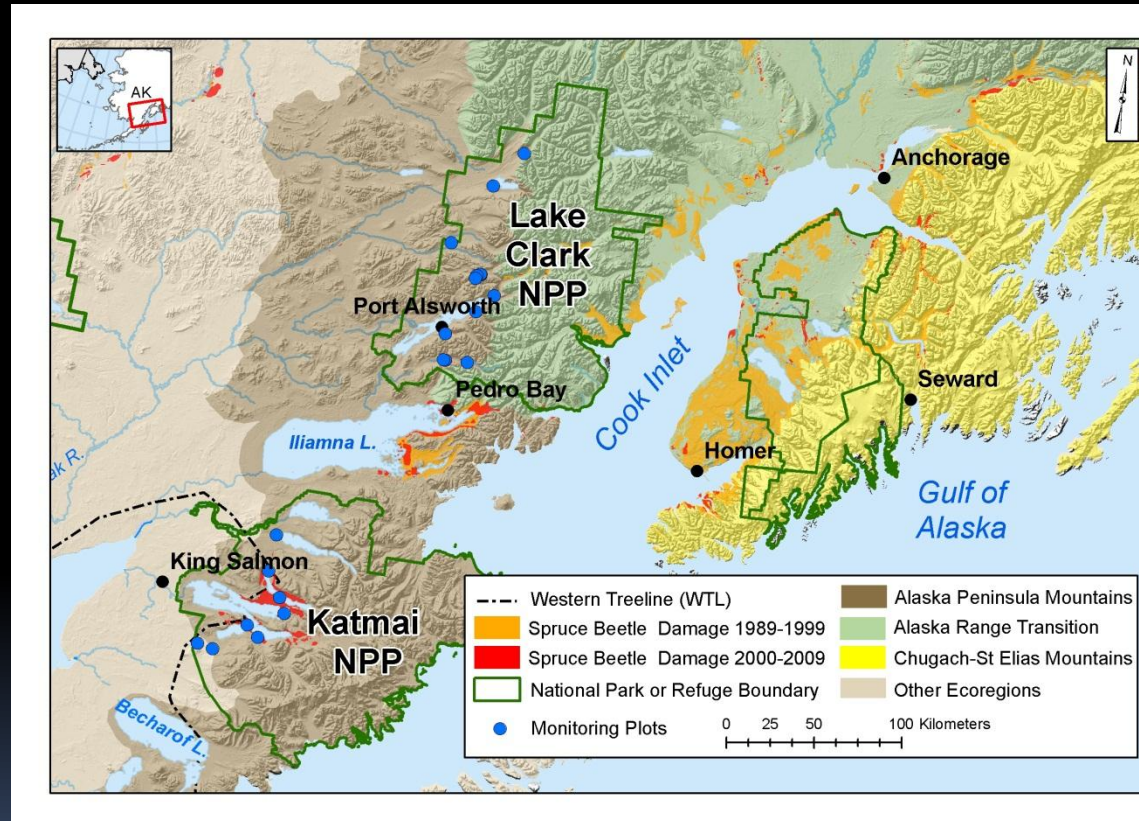


Widespread spruce beetle outbreaks

- **Southwest Alaska**
1810s, 1870s, 1900-10s, 1970s, 1990s-2000s
- **N Rocky Mountains**
1810s-20s, 1960s-70s, 2000s
- **S Rocky Mountains**
1860-80s, 1900s, 1970s, 2000s

Preliminary Findings: What are past and current effects of spruce beetle disturbance and climate warming on white spruce ecosystems?

- Tree growth responding favorably to recent warming
- High beetle mortality in forested sites
- Regeneration common, with high seedling densities in southern woodland sites
- Forest resiliency
 - Varied response to warming of forests to woodland ecosystems
 - Past and present context for global climate change effects



Acknowledgements

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